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Outcome analysis of upper and lower limb motor functions after anterior cervical discectomy and fusion for degenerative cervical disc disease

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ABSTRACT

Background: Anterior cervical discectomy and fusion (ACDF) is the most commonly performed surgical procedure for symptomatic cervical disc disease. In this study, we analysed the upper and lower limb motor functions after ACDF for disc prolapse in patients with degenerative cervical disc disease.

Methods: One hundred consecutive adult patients who underwent ACDF for single or two-level cervical disc prolapse during the study period (October 2015 to October 2017) were included in the study.

Results: Preoperative motor deficits in limbs were noted in 73% (73/100) of the patients. Enhance recovery of motor deficits was noted in 72.6% (53/73) of these patients and persisting motor deficits in the remaining patients (20/73- 27.4%). Five patients (5/27- 18.5%) without any preoperative motor deficits developed motor deficits after ACDF. Detailed pre and postoperative (at the time of discharge) motor power (graded by MRC grade) in all 4 limbs (Shoulder abduction / adduction / flexion / extension, elbow flexion / extension, wrist flexion / extension, hip abduction / adduction / flexion / extension, knee flexion/extension, ankle flexion/extension) was recorded. Statistically significant improvement in motor power (as recorded at the time of discharge) was noted in all the tested muscle groups after ACDF.

Conclusion: Early improvement in preoperative motor deficits can be expected in the majority of the patients with cervical PIVD following ACDF.

Keywords
anterior cervical discectomy and fusion, outcome, cervical disc degeneration

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Introduction

ACDF is most commonly done to treat a symptomatic cervical PIVD. (1, 16, 20, 22, 23, 25) ACDF is a safe procedure and is rarely associated with post-operative complications. (2, 7, 9, 12, 17) Significant proportion of patients shows remarkable recovery in motor deficits following ACDF. (11, 16) Authors in this publication analysed in detail the early recovery of motor deficits following ACDF for single or two level degenerative cervical PIVD.

Material and methods

One hundred consecutive adult patients who underwent ACDF for degenerative cervical PIVD during the study period (October 2015 to October 2017) were included in the study. Patients with traumatic PIVD were excluded. Approval from the institutional ethical committee was taken for this study. Detailed pre and postoperative (At the time of discharge) motor power (graded by MRC grade except hand grip which was subjectively graded from 0-100%) in all 4 limbs (Shoulder abduction / adduction / flexion / extension, elbow flexion / extension, wrist flexion / extension, hip abduction / adduction / flexion / extension, knee flexion / extension, ankle flexion / extension) were analysed.

Statistical analysis

Data analysis was done by using statistical software SPSS Statistics Version 24.0. Descriptive statistics including mean and standard deviation for continuous variables, and frequency and percentage for categorical variables were used for data expression. Appropriate tests like Chi-square test, Wilcoxon signed rank test etc. were used for checking statistically significant correlation. A probability (P) value of <0.05 was considered significant.

Results

Preoperative motor deficits in limbs were noted in 73% (73/100) of the patients. At the time of discharge, enhance recovery of motor deficits was noted in 72.6% (53/73) of these patients and persisting motor deficits in the remaining patients (20/73- 27.4%). Five patients (5/27- 18.5%) without any preoperative motor deficits developed motor deficits after ACDF. Pre and postoperative (At the time of discharge) motor power in all 4 limbs is compared in Tables 1-4. Statistically significant improvement in motor power at the time of discharge was recorded in all the tested muscle groups after ACDF.

Right upper limb	Preoperative (n=100)					Postoperative (n=100)				P-value
	Mean#	Median#	Range#	IQR		Mean#	Median#	Range#	IQR	
Shoulder										
Shoulder abduction	3.80±1.4	4	0-5	2		4.15±1.29	5	0-5	1	**0.001 (S)***
Shoulder adduction	3.80±1.4	4	0-5	2		4.16±1.29	5	0-5	1	**0.001 (S)***
Shoulder flexion	3.81±1.4	4	0-5	2		4.18±1.29	5	0-5	1	**0.001 (S)***
Shoulder extension	3.80±1.4	4	0-5	2		4.17±1.32	5	0-5	1	**0.001 (S)***

Elbow										
Elbow flexion	3.73±1.5	4	0-5	1		4.17±1.32	5	0-5	1	**0.001 (S)***
Elbow extension	3.71±1.5	4	0-5	2		4.16±1.33	5	0-5	1	**0.001 (S)***
Wrist										
Wrist flexion	3.71±1.6	4	0-5	1		4.14±1.27	5	0-5	1	**0.001 (S)***
Wrist extension	3.72±1.6	4	0-5	2		4.14±1.29	5	0-5	1	**0.001 (S)***

Right hand grip	Preoperative (Number of patients)		Postoperative (Number of patients)	P-value
0-25%	11		4	**0.001 (S)**†
25-50 %	11		13	
50-75 %	29		22	
75-100%	49		61	

Table 1. Comparison of preoperative and postoperative motor power in right upper limb.
#Power graded according to MRC grade.
*Obtained Using Wilcoxon signed rank test; † Obtained using Chi square test; S: Significant.

Left upper limb	Preoperative (n=100)					Postoperative (n=100)				P-value*
	Mean#	Median#	Range#	IQR		Mean#	Median#	Range #	IQR	
Shoulder										
Shoulder abduction	3.75±1.41	4	0-5	2		4.12±1.36	5	0-5	1	**0.001 (S)***
Shoulder adduction	3.74±1.41	4	0-5	2		4.14±1.34	5	0-5	1	**0.001 (S)***
Shoulder flexion	3.72±1.42	4	0-5	2		4.13±1.34	5	0-5	1	**0.001 (S)***
Shoulder extension	3.72±1.45	4	0-5	2		4.13±1.32	5	0-5	1	**0.001 (S)***
Elbow										

Elbow flexion	3.70±1.48	4	0-5	2		4.13±1.30	5	0-5	1	**0.001 (S)***
Elbow extension	3.70±1.48	4	0-5	2		4.13±1.29	5	0-5	1	**0.001 (S)***
Wrist										
Wrist flexion	3.64±1.51	4	0-5	1		4.2±1.26	5	0-5	1	**0.001 (S)***
Wrist extension	3.64±1.53	4	0-5	2		4.14±1.3	5	0-5	1	**0.001 (S)***

Left hand grip	Preoperative (Number of patients)		Postoperative (Number of patients)	P-value
0-25%	12		3	**0.001 (S)†**
25-50 %	11		13	
50-75 %	34		16	
75-100%	43		68	

Table 2. Comparison of preoperative and postoperative motor power in left upper limb.

#Power graded according to MRC grade

*Obtained Using Wilcoxon signed rank test; † Obtained using Chi square test; S: Significant

Right lower limb	Preoperative (n=100)				Postoperative (n=100)				P-value*
	Mean#	Median#	Range#	IQR	Mean#	Median#	Range#	IQR	
Hip									
Hip abduction	3.42±1.85	4	0-5	2	3.90±1.59	5	0-5	2	**0.001(S)**
Hip adduction	3.43±1.88	4	0-5	2	3.91±1.59	5	0-5	1	**0.001(S)**
Hip flexion	3.43±1.88	4	0-5	2	3.91±1.59	5	0-5	1	**0.001(S)**
Hip extension	3.42±1.88	4	0-5	2	3.88±1.59	5	0-5	2	**0.001(S)**
Knee									

Knee flexion	3.40±1.86	4	0-5	2	3.90±1.60	5	0-5	2	**0.001(S)**
Knee extension	3.38±1.86	4	0-5	2	3.90±1.59	5	0-5	2	**0.001(S)**
Ankle									
Ankle flexion	3.33±1.85	4	0-5	2	3.84±1.58	4.5	0-5	2	**0.001(S)**
Ankle extension	3.35±1.86	4	0-5	2	3.85±1.58	5	0-5	2	**0.001(S)**

Table 3. Comparison of preoperative and postoperative motor power in right lower limb.
#Power graded according to MRC grade
*Obtained Using Wilcoxon signed rank test; S: Significant

Left lower limb	Preoperative (n=100)				Postoperative (n=100)				P-value*
	Mean	Median	Range	IQR	Mean	Median	Range	IQR	
Hip									
Hip abduction	3.32±1.86	4	0-5	2	3.98±1.53	5	0-5	1	**0.001 (S)**
Hip adduction	3.33±1.87	4	0-5	2	3.99±1.52	5	0-5	1	**0.001 (S)**
Hip flexion	3.32±1.86	4	0-5	2	4.00±1.49	5	0-5	1	**0.001 (S)**
Hip extension	3.29±1.84	4	0-5	2	3.98±1.49	5	0-5	1	**0.001 (S)**
Knee									
Knee flexion	3.27±1.83	4	0-5	2	3.95±1.52	5	0-5	1	**0.001 (S)**
Knee extension	3.27±1.84	4	0-5	2	3.94±1.51	5	0-5	1	**0.001 (S)**
Ankle									
Ankle flexion	3.22±1.89	4	0-5	3	3.88±1.55	5	0-5	2	**0.001 (S)**
Ankle extension	3.20±1.89	4	0-5	3	3.89±1.56	5	0-5	2	**0.001 (S)**

Table 4. Comparison of preoperative and postoperative motor power in right lower limb.
#Power graded according to MRC grade
*Obtained Using Wilcoxon signed rank test; S: Significant

Discussion

Cervical PIVD is a common degenerative disc disease affecting millions of people. (24) Cervical disc herniation can occur as a result of ageing, wear and tear, or sudden stress from an accident.(5) Majority of these patients present with neck pain radiating to upper limbs. (24) Other presenting symptoms include motor deficits, stiffness in limbs, sensory deficits, paresthesias in limbs etc. (16, 24) Majority of the patients presenting with only neck pain or radicular pain can be managed with medicationas and conservative measures like physiotherapy, cervical collar etc. Patients with significant pain not responding to conservative measures and patients with neurological deficits like sensory/motor deficits and bladder symptoms respond well to surgery. (10, 16, 21)

ACDF is a common surgical procedure performed for symptomatic degenerative cervical disc disease. (6, 16) It helps to relieve the pressure on nerve roots and/or on the spinal cord, (14) thus resulting in improvement in various clinical symptoms including

neck pain, radicular pain, motor weakness, sensory symptoms, tightness in limbs and bladder disturbances. (10, 13, 16) Various complications reported with ACDF include dysphagia, hoarseness of voice, wound hematoma, graft migration, pseudoarthrosis, wound infection etc. (13) Patients can rarely have sensory or motor deficits after ACDF due to small risk of damage to the spinal cord, nerve roots or both. (10, 13, 16)

Improvement in neurological deficits ranging from 36-93% has been reported in various series after ACDF.(3, 13, 15, 16, 18) Lehman et al (16) reported preoperative motor deficits in 55% of the patients and reported recovery of these deficits in 95% of them at 1 year. Chiles et al(4) reported strength improvement rates ranging form 79.1% to 90.9% in various individual muscle groups of upper and lower limbs following ACDF. In the present study very high proportion of patients (73%) presented with motor deficits and early complete recovery of these deficits were noted in 72.6% (53/73) of these patients.

Majority of the studies on ACDF have graded neurological deficits using various scores like Nurick's grade, JOA, modified JOA scores etc. which combine both sensory and motor deficits. (4, 8, 16, 19) Detailed assessment of motor deficits with grading of motor power for various muscle groups has not been done in most of the studies on ACDF. (8, 16) In the present study we compared the preoperative motor power and early postoperative (at the time of discharge) motor power following ACDF in all major groups of muscles of lower and upper extremity and found that significant improvement in motor power in early postoperative period. Long term follow-up studies in patients following ACDF is required as they can develop new deficits secondary to adjacent segment disease. (16)

Conclusion

Early improvement in preoperative motor deficits can be expected in majority of the patients with degenerative cervical PIVD following ACDF.

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